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Information on Over-the-Horizon Radar
PART XVII
[Unclassified Title]

G. A. SKAGGS

Radar Techniques Branch
Radar Division

April 1969

[redacted]

NAVAL RESEARCH LABORATORY
Washington, D.C.

[redacted]

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Information on Over-the-Horizon Radar
Part XVII - Exposure of Fire Detector Sensor Heads to a High-Level Pulsed HF Field

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ABSTRACT

([redacted])

The sensor heads of a fire detection system were subjected to a high-level pulsed RF field in the HF frequency band. They retained their satisfactory operation at exposure levels greater than 2500 volts/meter (peak).

PROBLEM STATUS

This is an interim report on one phase of the problem; work is continuing on this phase and other phases of the problem.

AUTHORIZATION

USAF MIPR (30-602) 64-3412 to the
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dated 26 March 1964
NRL Problem 53R02-42

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INFORMATION ON OVER-THE-HORIZON RADAR
PART XVII - EXPOSURE OF FIRE DETECTOR SENSOR HEADS TO A HIGH-LEVEL PULSED HF FIELD
(Unclassified Title)

INTRODUCTION

The Radar Techniques Branch was requested to test a set of sensor heads for a fire detection system which will be installed at an HF radar site. The purpose of the test was to determine the RF field intensity at HF frequencies to which the sensors could be subjected and still retain satisfactory operation.

DESCRIPTION OF SENSORS

The sensor or detector heads which were tested are part of a fire detection system manufactured by Minerva Fire Defense Ltd., Twickenham, England. Four detector heads were supplied for testing. The F35 and F50 combustion gas detectors are ionization types of sensors. The presence of combustion gas products in an exposed ionization chamber will generate an alarm signal. The F60 smoke detector is a photoelectric sensor and the F70 flame detector is an infrared sensor. Further circuit details regarding the detectors are company confidential and will not be presented in this report. Physically the detectors are about 2-1/2" diameter by 3-3/4" long and are constructed with an aluminum outer shell. Visual examination reveals that the detector heads are very nearly self-shielded at HF frequencies. Also supplied was a demonstration box and a marine deckhead fitting containing a socket for the plug-in detector heads.

MEASUREMENT TECHNIQUES

The detector heads (Fig. 1) were mounted in the marine fitting (Fig. 2) and connected by means of a 250-foot-long shielded cable to the demonstration box (Fig. 3). The fitting was then placed on the ground screen in the near-field region of a vertically polarized HF antenna (Figs. 4 and 5) and exposed to a high-level pulsed RF field. The magnitude of the RF field at the test frequencies was determined by substitution. A field-strength meter was placed in the same location as the marine fitting and a low power CW signal applied to the antenna input terminal. A record was made of the power level and the resulting field strength. The results of the low power measurements were extrapolated to obtain the field strength at the high power level.

The high power field was generated by a transmitter which has a rated output of 4.6-Mw peak over the frequency range of 10 MHz to 30 MHz. The generated waveform (Fig. 6) was a cosine-squared pulse with a base length of 650 microseconds, a PRF of 90 Hz, and a duty factor of 0.022.

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RESULTS

The following data were obtained.

Frequency	Reference (CW)		Test Field (Pulsed)	
	Power	Field	Power	Field
MHz	dBw	v/m	dBw	v/m
10.087	-1.02	1.38	+64.63	2643
18.100	-1.12	0.56	+66.63	1372
26.600	-1.66	0.67	+65.63	1546

All of the detector heads were exposed to the above high power fields while mounted in the marine fitting. In addition the F70 detector was exposed to the 18.1 MHz field and the F35 detector to the 26.6 MHz field with the guard of the marine fitting removed. In all cases there was no triggering or false alarms during the high power testing. Checks were made both before and after the RF testing to insure that the detectors were operating properly. Cigar smoke was blown through the F35, F50, and F60 heads thus causing an alarm to be generated. The F70 head was triggered by heat from the glow of the cigar held near the detector.

It should be pointed out that the field-strength meter used to obtain the data was calibrated for use in the far-field region. As a result its use in the near-field region yields data which are not absolutely correct. No attempt was made to compensate for the near-field effects.

CONCLUSION

The detector heads, when mounted in the marine deckhead fittings and with all wiring shielded (enclosed in conduit), will withstand pulsed RF fields of 2643 volts/meter (peak) in the HF frequency band and still retain satisfactory operation. This field intensity is 22.7 dB above the accepted 10 mw/cm^2 limit for personnel safety. It would be possible to use the detector heads in high-level HF fields without the deckhead fittings if the protective finish was removed from between the metal joints of the shell and a shielded grounding-type socket developed.

ACKNOWLEDGMENT

The author acknowledges the help and assistance of Mr. F. E. Boyd.

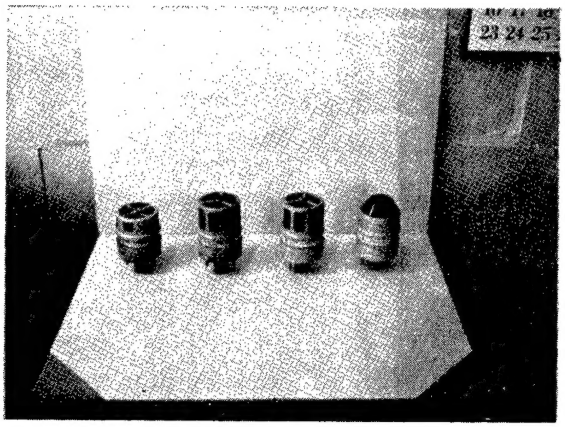


Fig. 1 - Fire detector heads

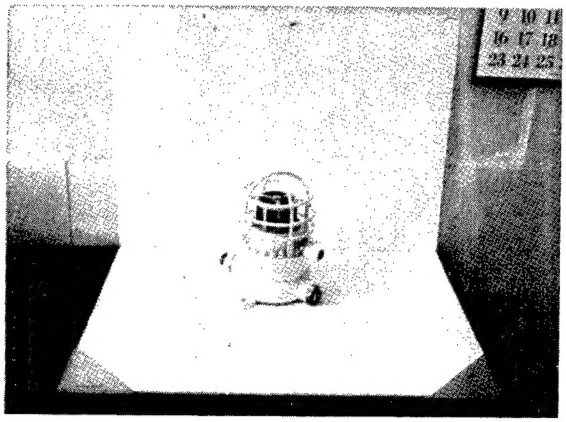
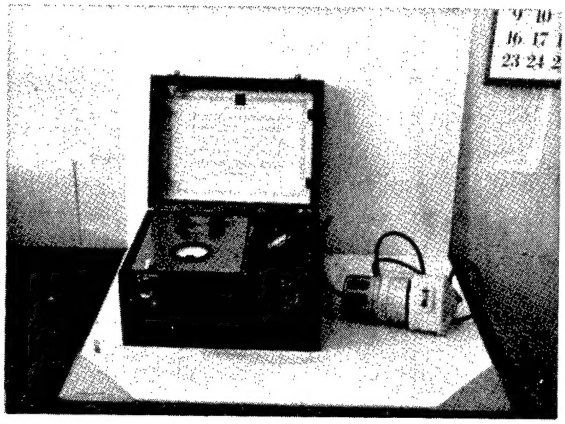


Fig. 2 - Marine deckhead fitting



Fig, 3 - Demonstration box

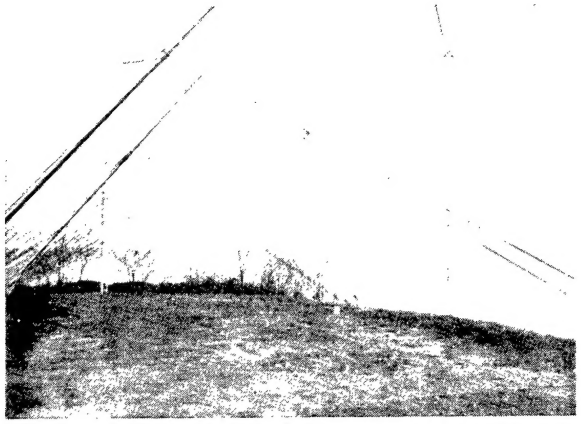


Fig. 4 - Fitting in test antenna field

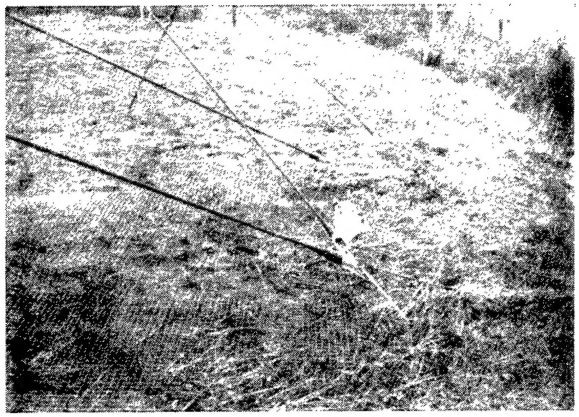


Fig. 5 - Closeup of Fig. 4

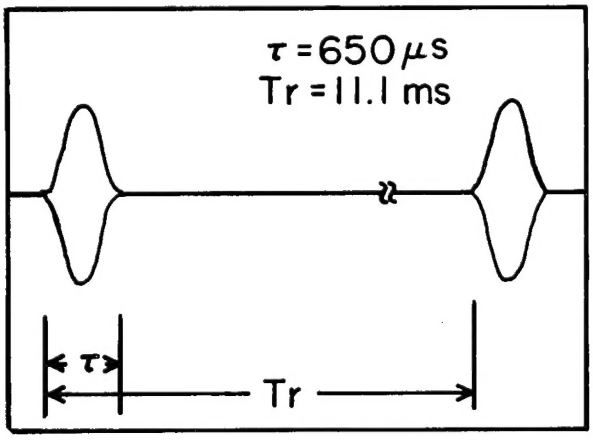


Fig. 6 - Transmitter output waveform

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G. A. Skaggs

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13. ABSTRACT

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